# A modern format for ENSDF?

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# Background

- ENSDF: premier source of nuclear structure and decay data.
- Serves a multitude of applications and problem-specific databases.
- Reformatted into RIPL—used by many reaction-modeling codes (EMPIRE, TALYS, COH) to generate ENDF evaluations.
- Provides reaction data that drive radiation-transport calculations (MCNP).
- NA-22 applications: EGAF compares ENSDF with statistical-model calculations.

# Problem

- ENSDF is based on obsolete 80-character mixed-record punchcard.
- Difficult to parse and restrictive.
- Not easily extensible: "Comment fields" (not standardised) used to capture additional data.
- Difficult to write applications that can manipulate format making data dissemination to a broad user base challenging.
- NDWG Topic Area: "Revitalizing the Nuclear Data Pipeline" (PI: David Brown, BNL); Task 1: "Nuclear Structure Data Infrastructure Modernization" (LBNL/UCB,LLNL,BNL).

# Solution

- Develop translation software to create XML-structured hierarchy consistent with the GND format (Mattoon, LLNL).
- Initiative already began to parse ENSDF data sets: (i) to extract numerical data for general purposes; (ii) generate RIPL format for specific applications.
- Interpreted data can be represented in different format.
- Feasability study: XML-hierarchy for "some" records presented at IAEA NSDD Meeting 2015.
- **IAEA Action Item #8** $\Rightarrow$ Generate representative XML schema for all standard one-card (primary) records in ENSDF and present at Nuclear Data Week.

# Status

- Representative XML-translation for all standard one-card (primary) ENSDF records is available in the LBNL lab report.
- "An XML-hierarchical data structure for ENSDF", A. M. Hurst, LBNL-1004483 (March, 2016)
  https://pubarchive.lbl.gov/islandora/object/ir%3A1004483
- Presented at Nuclear Data Week, BNL, 2015 (Lee Bernstein), and liaised documentation with network.
- Thanks to David Brown (BNL) and Caleb Mattoon (LLNL) for feedback!
- **Not a funded activity at present**
- Future work: QA and continuation records (already began, e.g., particle-decay modes for RIPL translation).
- Round-trip translation: ENSDF-to-XML; XML-to-ENSDF.
- Comment records?

# Risks

- Current effort **does not impact** adopted ENSDF practices and procedures.
- Any future effort should not "disturb" evaluators.
- Risk #1: Instability of GND format; changes to GND impact XML.
- Risk #2: Several analysis and utility codes for ENSDF built up around existing infrastructure.
- Backward-compatibility important during lengthy transition phase.
- Risk #3: Comments are not standardized but contain valuable data.

# The Gamma "G" record

```
<decay mode="gamma">
  <gammaEnergy value="223.2368" unit="keV">
    <uncertainty value="0.0013" pdf="normal"/>
  </gammaEnergy>
  <branchingRatio value="0.730">
    <uncertainty value="0.005" pdf="normal"/>
  </branchingRatio>
  <multipolarity value="M1+E2"/>
  <mixingRatio value="0.114" sign="-">
    <uncertainty value="0.014" pdf="normal"/>
  </mixingRatio>
  <totalICC value="0.0975">
    <uncertainty value="0.0000" pdf="NA"/>
  </totalICC>
  <relativeTotalIntensity value="0.801175" method="calculatedUsingRIandCC">
    <uncertainty value="0.0054875" pdf="normal"/>
  </relativeTotalIntensity>
  <commentFlag record="None" classification="None"/>
  <coincidence record="None" classification="None"/>
  <assignment record="None" classification="firm"/>
  <finalLevel>
    <flevel id="Cs133_2" index="2"/>
    <fenergy value="160.6121" unit="keV"/>
  </finalLevel>
</decay>
```

```
---  ENSDF_133Cs.xml   58% (294,84)   (XML)----------------------------------------
133CS  G 223.2368  13 0.730   5M1+E2     -0.114  14    0.0975
```